



RADIO TEST REPORT

Test Report No. : 11837856S-B-R3

Applicant : CASIO COMPUTER CO., LTD.
Type of Equipment : Wireless Module
Model No. : K1506M
FCC ID : BBQGZE1P
Test regulation : FCC Part 15 Subpart C: 2017
Test Result : Complied

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2. The results in this report apply only to the sample tested.
3. This sample tested is in compliance with the above regulation.
4. The test results in this report are traceable to the national or international standards.
5. The opinions and the interpretations to the result of the description in this report are outside scopes where UL Japan has been accredited.
6. This test report covers Radio technical requirements. It does not cover administrative issues such as Manual or non-Radio test related Requirements. (if applicable)
7. This report is a revised version of 11837856S-B-R2. 11837856S-B-R2 is replaced with this report.

Date of test: July 4 to August 12, 2017

Representative test engineer:


Kazutaka Takeyama
Engineer
Consumer Technology Division

Approved by:


Akio Hayashi
Leader
Consumer Technology Division



- ☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan.
☒ There is no testing item of "Non-accreditation".

UL Japan, Inc.

Shonan EMC Lab.

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13-EM-F0429

REVISION HISTORY

Original Test Report No.: 11837856S-B

[illegible]

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SECTION 1: Customer information

Company Name	:	CASIO COMPUTER CO., LTD.
Address	:	2-1, Sakaecho 3-chome, Hamura-shi Tokyo 205-8555, Japan
Telephone Number	:	+81-42-579-7521
Facsimile Number	:	+81-42-579-7157
Contact Person	:	Hidetoshi Sumi

SECTION 2: Equipment under test (E.U.T.)

2.1 Identification of E.U.T.

Type of Equipment	:	Wireless Module
Model No.	:	K1506M
Serial No.	:	Refer to Section 4, Clause 4.2
Rating	:	DC 3.7 V / DC 5 V
Receipt Date of Sample	:	July 3, 2017
Country of Mass-production	:	China
Condition of EUT	:	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification of EUT	:	No Modification by the test lab

2.2 Product Description

Model: K1506M (referred to as the EUT in this report) is a Wireless Module.

Radio Specification

[Bluetooth Low Energy]

Radio Type	:	Transceiver
Frequency of Operation	:	2402 MHz - 2480 MHz
Modulation	:	GFSK
Power Supply (radio part input)	:	DC 3.3 V
Antenna type	:	Dipole antenna
Antenna Gain	:	0.96 dBi
Operating Temperature	:	-10 deg. C to +40 deg. C
Clock frequency(ies) in the system	:	26 MHz

SECTION 3: Test specification, procedures & results

3.1 Test Specification

Test Specification : FCC Part 15 Subpart C
FCC Part 15 final revised on November 2, 2017

Title : FCC 47CFR Part15 Radio Frequency Device Subpart C Intentional Radiators
Section 15.207 Conducted limits
Section 15.247 Operation within the bands 902-928MHz,
2400-2483.5MHz, and 5725-5850MHz

* The revision on November 2, 2017, does not affect the test specification applied to the EUT.

3.2 Procedures and results

Item	Test Procedure	Specification	Worst margin	Results	Remarks
Conducted Emission	FCC: ANSI C63.10-2013 6. Standard test methods IC: RSS-Gen 8.8	FCC: Section 15.207 IC: RSS-Gen 8.8	QP 19.9 dB, 0.40855 MHz, N, BLE 2440 MHz USB circuit side	Complied	-
6dB Bandwidth	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(a)(2) IC: RSS-247 5.2(a)	See data.	Complied	Conducted
Maximum Peak Output Power	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.12	FCC: Section 15.247(b)(3) IC: RSS-247 5.4(d)		Complied	Conducted
Power Density	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: -	FCC: Section 15.247(e) IC: RSS-247 5.2(b)		Complied	Conducted
Spurious Emission Restricted Band Edges	FCC: KDB 558074 D01 DTS Meas Guidance v04 IC: RSS-Gen 6.13	FCC: Section 15.247(d) IC: RSS-247 5.5 RSS-Gen 8.9 RSS-Gen 8.10	7.9 dB 431.990 MHz, QP, Vertical. Tx BT LE 2480 MHz	Complied	Conducted (below 30 MHz)/ Radiated (above 30 MHz) *1)

Note: UL Japan, Inc.'s EMI Work Procedures No. 13-EM-W0420 and 13-EM-W0422.

*1) Radiated test was selected over 30 MHz based on section 15.247(d) and KDB 558074 D01 DTS Meas Guidance v04 12.2.7.

* In case any questions arise about test procedure, ANSI C63.10: 2013 is also referred.

FCC Part 15.31 (e)

The EUT provides stable voltage (DC 3.3 V) constantly to the RF module regardless of input voltage.
Therefore the EUT complies with the requirement.

FCC Part 15.203/212 Antenna requirement

The EUT has an external antenna connector.
The module and Antenna are contacted by the Spring finger connector, and they are mechanically fixed by being installed by the professionals. Therefore, the equipment complies with the antenna requirement of Section 15.203.

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3.3 Addition to standard

Item	Test Procedure	Specification	Worst margin	Results	Remarks
99% Occupied Bandwidth	IC: RSS-Gen 6.6	IC: -	N/A	-	Conducted

Other than above, no addition, exclusion nor deviation has been made from the standard.

3.4 Uncertainty

EMI

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k = 2$.

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Item	Frequency range	Uncertainty (+/-)				
		No. 1 SAC / SR	No. 2 SAC / SR	No. 3 SAC / SR	No. 4 SAC / SR	No. 5,6,8 SR
Conducted emission (AC Mains) LISN	150 kHz-30 MHz	2.6 dB	2.5 dB	2.6 dB	2.5 dB	2.5 dB
Radiated emission (Measurement distance: 3 m)	9 kHz-30 MHz	3.1 dB	3.1 dB	3.1 dB	-	-
	30 MHz-200 MHz	4.6 dB	4.4 dB	4.6 dB	-	-
	200 MHz-1 GHz	5.8 dB	5.7 dB	5.8 dB	-	-
	1 GHz-13 GHz	4.9 dB	4.9 dB	4.9 dB	-	-
Radiated emission (Measurement distance: 1 m)	13 GHz-18 GHz	4.6 dB	4.6 dB	4.6 dB	-	-
	18 GHz-40 GHz	4.9 dB	4.9 dB	4.9 dB	-	-

SAC=Semi-Anechoic Chamber

SR= Shielded Room is applied besides radiated emission

Antenna terminal test	Uncertainty (+/-)
Power Measurement above 1 GHz (Average Detector)_SPM-06	0.72 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-06	0.85 dB
Power Measurement above 1 GHz (Average Detector)_SPM-07	0.74 dB
Power Measurement above 1 GHz (Peak Detector)_SPM-07	0.91 dB
Spurious emission (Conducted) below 1GHz	1.6 dB
Spurious emission (Conducted) 1 GHz-3 GHz	1.3 dB
Spurious emission (Conducted) 3 GHz-18 GHz	2.2 dB
Spurious emission (Conducted) 18 GHz-26.5 GHz	2.3 dB
Spurious emission (Conducted) 26.5 GHz-40 GHz	2.4 dB
Bandwidth Measurement	1.01 %
Duty cycle and Time Measurement	0.012 %

Conducted Emission test

The data listed in this test report has enough margin, more than the site margin.

Radiated emission test

The data listed in this test report has enough margin, more than the site margin.

3.5 Test Location

UL Japan, Inc. Shonan EMC Lab.
 1-22-3, Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 JAPAN
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 JAB Accreditation No. RTL02610
 FCC Test Firm Registration Number: 839876

Test site	IC Registration Number	Width x Depth x Height (m)	Size of reference ground plane (m) / horizontal conducting plane	Maximum measurement distance
No.1 Semi-anechoic chamber	2973D-1	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.2 Semi-anechoic chamber	2973D-2	20.6 x 11.3 x 7.65	20.6 x 11.3	10 m
No.3 Semi-anechoic chamber	2973D-3	12.7 x 7.7 x 5.35	12.7 x 7.7	5 m
No.4 Semi-anechoic chamber	-	8.1 x 5.1 x 3.55	8.1 x 5.1	-
No.1 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.2 Shielded room	-	6.8 x 4.1 x 2.7	6.8 x 4.1	-
No.3 Shielded room	-	6.3 x 4.7 x 2.7	6.3 x 4.7	-
No.4 Shielded room	-	4.4 x 4.7 x 2.7	4.4 x 4.7	-
No.5 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.6 Shielded room	-	7.8 x 6.4 x 2.7	7.8 x 6.4	-
No.8 shielded room	-	3.45 x 5.5 x 2.4	3.45 x 5.5	-
No.1 Measurement room	-	2.55 x 4.1 x 2.5	-	-

3.6 Test data, Test instruments, and Test set up

Refer to APPENDIX.

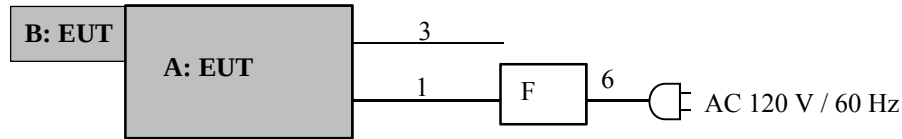
SECTION 4: Operation of E.U.T. during testing

4.1 Operating Mode(s)

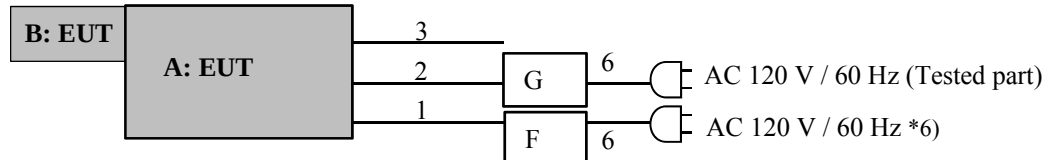
Mode	Frequency	Remarks*
Bluetooth Low Energy	2402 MHz, 2440 MHz, 2480 MHz	PN9
*Power of the EUT was set by the software as follows; - Power Setting: Fixed - Software: HCI tester Application Version 1.0.0.1 *This setting of software is the worst case. Any conditions under the normal use do not exceed the condition of setting. In addition, end users cannot change the settings of the output power of the product.		

4.2 Configuration and peripherals

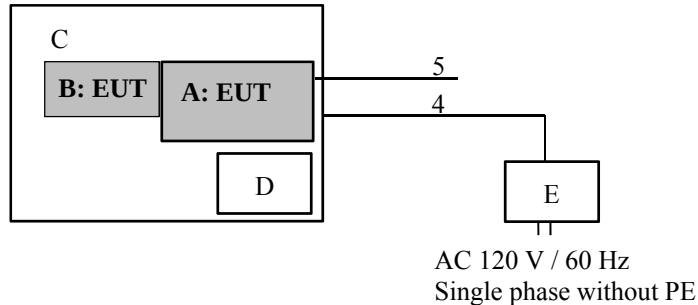
[Conducted emission tests (battery circuit side) and Antenna terminal conducted test]



[Conducted emission tests (USB circuit side)]



[Radiated emission tests]



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Wireless Module	K1506M	005 *1) 202 *2) 219 *3)	Casio Computer Co., Ltd.	EUT
B	Antenna	-	-	Casio Computer Co., Ltd.	EUT
C	Digital Camera	GZE-1	91	Casio Computer Co., Ltd.	*4)
D	Battery	NP-150	-	Casio Computer Co., Ltd.	-
E	AC Adaptor	AD-C54UJ	-	Casio Computer Co., Ltd.	-
F	DC power supply	PAN35-10A	NA000955	Kikusui	-
G	DC power supply	PAN35-10A	DE001677	Kikusui	-

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	DC	0.15+0.7	Unshielded	Unshielded	DC 4.0 V *5)
2	DC	1.0	Unshielded	Unshielded	DC 5.0 V
3	Signal	0.15	Unshielded	Unshielded	-
4	USB	0.8	Shielded	Shielded	-
5	Signal	0.15	Unshielded	Unshielded	-
6	AC	2.00	Unshielded	Unshielded	-

*1) Used for Antenna Terminal conducted test

*2) Used for Conducted Emission test

*3) Used for Radiated Emission test

*4) Since the EUT does not have own shielding, the radiated emission test was applied with representative host.

*5) The testing was performed with DC 4.0 V as a representative as a test voltage according to the customer's request.

*6) As a product specification, power input to the battery terminal is monitored and the EUT will not operate without this power input. Therefore, the test had also been performed with power input (DC4.0 V) of the battery terminal, even though the power supplied from the USB power supply. (As a specification of the product, USB circuit side has given priority to power supply to the RF part.)

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SECTION 5: Conducted Emission

Test Procedure and conditions

EUT was placed on a urethane platform of nominal size, 1.0 m by 1.5 m / 2.0 m, raised 0.8 m above the conducting ground plane.

The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT aligned and flushed with rear of tabletop. EUT was located 80 cm from a Line Impedance Stabilization Network (LISN) / Artificial mains Network (AMN) and excess AC cable was bundled in center.

The AC Mains Terminal Continuous disturbance Voltage has been measured with the EUT in a Semi Anechoic Chamber.

The EUT was connected to a LISN (AMN).

An overview sweep with peak detection has been performed.

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Detector	: QP and CISPR AV
Measurement range	: 0.15 MHz – 30 MHz
Test data	: APPENDIX
Test result	: Pass

SECTION 6: Radiated Spurious Emission

Test Procedure

It was measured based on "11.0 Emissions in non-restricted frequency bands" of "KDB 558074 D01 DTS Meas Guidance v04".

[For below 1 GHz]

EUT was placed on a platform of nominal size, 0.5 m by 0.5 m, raised 0.8 m above the conducting ground plane. The table is made of Styrofoam and covered with polyvinyl chloride. That has very low permittivity. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with a ground plane.

[For above 1 GHz]

EUT was placed on a urethane platform of nominal size, 0.5 m by 0.5 m, raised 1.5 m above the conducting ground plane. The Radiated Electric Field Strength has been measured in a Semi Anechoic Chamber with absorbent materials lined on a ground plane.

The height of the measuring antenna varied between 1 and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field strength.

The measurements were performed for both vertical and horizontal antenna polarization with the Test Receiver, or the Spectrum Analyzer.

The measurements were made with the following detector function of the test receiver and the Spectrum analyzer (in linear mode).

The test was made with the detector (RBW/VBW) in the following table.

When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

Test Antennas are used as below;

Frequency	30 MHz to 200 MHz	200 MHz to 1 GHz	Above 1 GHz
Antenna Type	Biconical	Logperiodic	Horn

In any 100 kHz bandwidth outside the restricted band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator confirmed 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on a radiated measurement.

20 dBc was applied to the frequency over the limit of FCC 15.209 / Table 4 of RSS-Gen 8.9(IC) and outside the restricted band of FCC15.205 / Table 6 of RSS-Gen 8.10 (IC).

Frequency	Below 1 GHz	Above 1 GHz		20 dBc
Instrument used	Test Receiver	Spectrum Analyzer		Spectrum Analyzer
Detector	QP	PK	AV *1)	PK
IF Bandwidth	BW 120 kHz	RBW: 1 MHz VBW: 3 MHz	Average Power Method: <u>12.2.5.2</u> RBW: 1 MHz VBW: 3 MHz Detector: Power Averaging (Linear voltage) Trace: 100 traces Duty factor was added to the results.	RBW: 100 kHz VBW: 300 kHz
Test Distance	3 m	3.97 m *2) (1 GHz – 13 GHz), 1 m *3) (13 GHz – 26.5 GHz)		3.97 m *2) (1 GHz – 13 GHz), 1 m *3) (13 GHz – 26.5 GHz)

*1) Average Power Measurement was performed based on 6.0 & 12.2.5 of "KDB 558074 D01 DTS Meas Guidance v04".

*2) Distance Factor: $20 \times \log(3.97 \text{ m} / 3.0 \text{ m}) = 2.43 \text{ dB}$

*3) Distance Factor: $20 \times \log(1.0 \text{ m} / 3.0 \text{ m}) = -9.54 \text{ dB}$

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- The carrier level and noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

EUT polarization	Carrier	Spurious (Below 1 GHz)	Spurious (1 GHz -13 GHz)	Spurious (13 GHz -18 GHz)	Spurious (18 GHz -26.5 GHz)
Horizontal	X	Z	Y	X	Z
Vertical	Z	X	Z	X	Z

The test results and limit are rounded off to one decimal place, so some differences might be observed.

Measurement range : 30 MHz - 26.5 GHz
Test data : APPENDIX
Test result : Pass

SECTION 7: Antenna Terminal Conducted Tests

Test Procedure

The tests were made with below setting connected to the antenna port.

Test	Span	RBW	VBW	Sweep time	Detector	Trace	Instrument used
6dB Bandwidth	10 MHz	100 kHz	300 kHz	Auto	Peak	Max Hold	Spectrum Analyzer
99% Occupied Bandwidth *1)	Enough width to display emission skirts	1 to 5 % of OBW	Three times of RBW	Auto	Sample	Max Hold	Spectrum Analyzer
Maximum Peak Output Power	-	-	-	Auto	Peak/ Average *2)	-	Power Meter (Sensor: 50 MHz BW)
Peak Power Density	1.5 times the 6dB Bandwidth	3 kHz	9.1 kHz	Auto	Peak	Max Hold	Spectrum Analyzer *3)
Conducted Spurious Emission *4)	9kHz to 150kHz	200 Hz	620 Hz	Auto	Peak	Max Hold	Spectrum Analyzer
	150kHz to 30MHz	10 kHz	30 kHz				
*1) Max hold was applied as Worst-case measurement. *2) Reference data *3) Section 10.2 Method PKPSD (peak PSD) of "KDB 558074 D01 DTS Meas Guidance v04". *4) In the frequency range below 30MHz, RBW was narrowed to separate the noise contents. Then, wide-band noise near the limit was checked separately, however the noise was low enough as shown in the chart. (9 kHz - 150 kHz: RBW = 200 Hz, 150 kHz - 30 MHz: RBW = 10 kHz)							

The test results and limit are rounded off to two decimals place, so some differences might be observed.

Test data : APPENDIX
Test result : Pass

APPENDIX 1: Test data

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

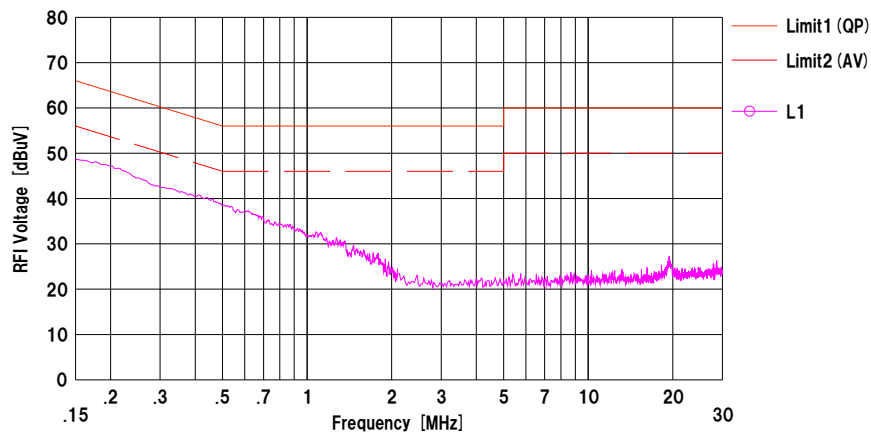
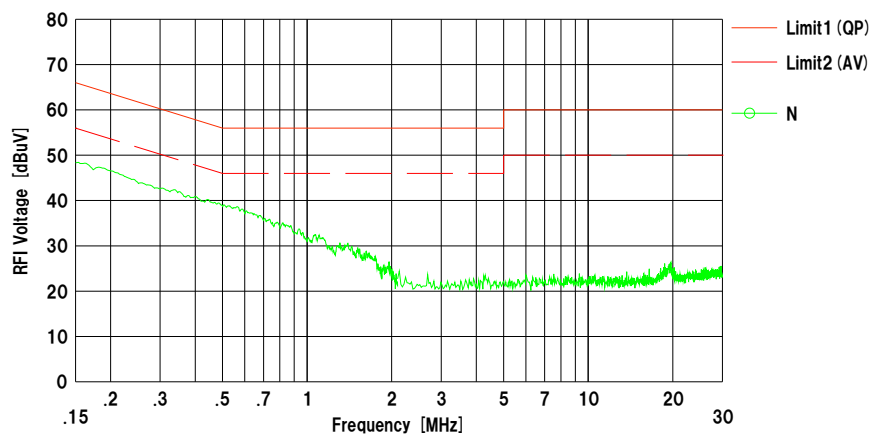
UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/07/06

Mode : BLE 2402MHz
Power : AC 120 V / 60 Hz (DC 4 V)
Temp./Humi. : 25 deg.C / 58 %RH

Remarks : Battery circuit side

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Engineer : Yosuke Ishikawa



Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-05

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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

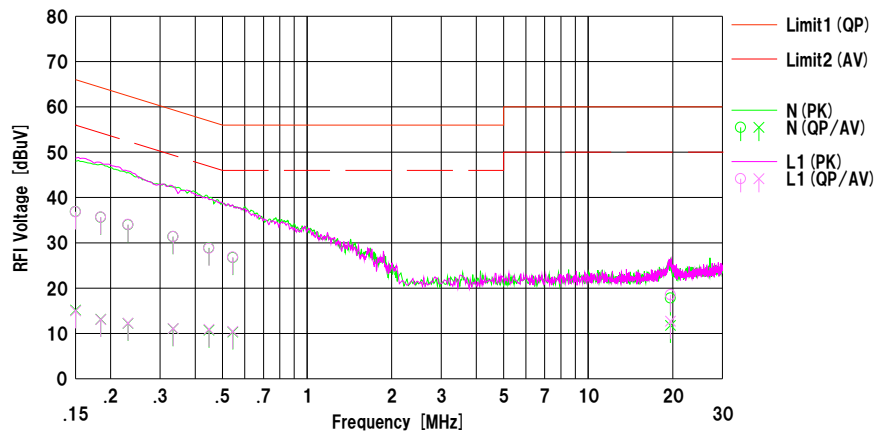
UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/07/06

Mode : BLE 2440MHz
Power : AC 120 V / 60 Hz (DC 4 V)
Temp./Humi. : 25 deg.C / 58 %RH

Remarks : Battery circuit side

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Engineer : Yosuke Ishikawa



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15013	24.48	2.75	12.41	36.89	15.16	65.99	55.99	29.1	40.8	N	
2	0.18457	23.22	0.73	12.40	35.62	13.13	64.28	54.28	28.6	41.1	N	
3	0.23062	21.57	-0.18	12.41	33.98	12.23	62.43	52.43	28.4	40.2	N	
4	0.33383	18.92	-1.40	12.43	31.35	11.03	59.36	49.36	28.0	38.3	N	
5	0.44787	16.44	-1.70	12.43	28.87	10.73	56.91	46.91	28.0	36.1	N	
6	0.54417	14.31	-2.11	12.44	26.75	10.33	56.00	46.00	29.2	35.6	N	
7	19.62045	4.48	-1.57	13.35	17.81	11.78	60.00	50.00	42.1	38.2	N	
8	0.15021	24.41	2.57	12.41	36.82	14.99	65.99	55.99	29.1	41.0	L1	
9	0.18455	23.31	0.67	12.40	35.71	13.07	64.28	54.28	28.5	41.2	L1	
10	0.23071	21.66	-0.12	12.41	34.07	12.29	62.42	52.42	28.3	40.1	L1	
11	0.33387	18.95	-1.33	12.43	31.38	11.10	59.35	49.35	27.9	38.2	L1	
12	0.44781	16.37	-1.53	12.43	28.80	10.90	56.92	46.92	28.1	36.0	L1	
13	0.54411	14.40	-1.98	12.44	26.84	10.46	56.00	46.00	29.1	35.5	L1	
14	19.62033	5.19	-0.64	13.35	18.54	12.71	60.00	50.00	41.4	37.2	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-05

Conducted Emission

DATA OF CONDUCTED EMISSION TEST

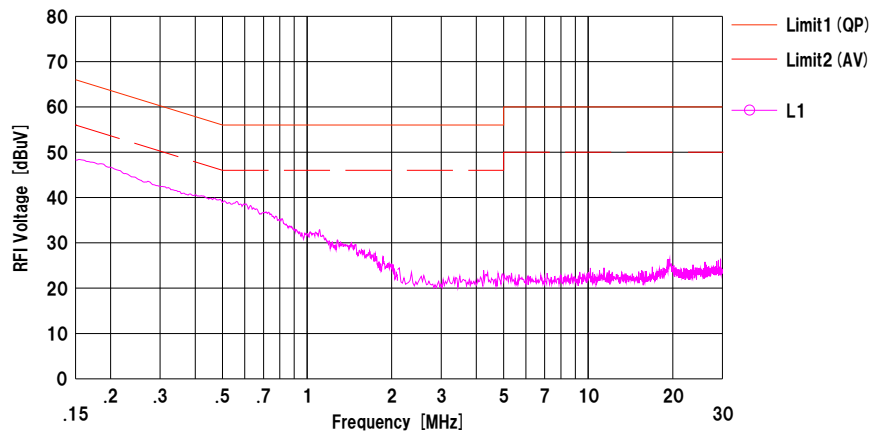
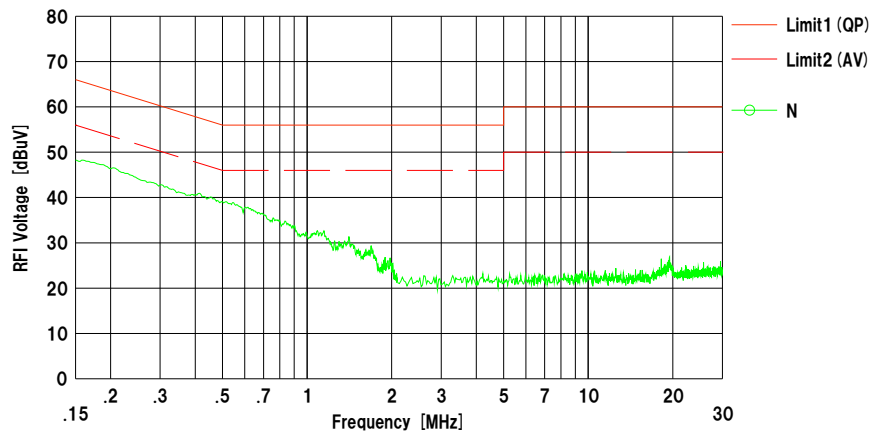
UL Japan, Inc. Shonan EMC Lab. No.3 Shielded Room
Date : 2017/07/06

Mode : BLE 2480MHz
Power : AC 120 V / 60 Hz (DC 4 V)
Temp./Humi. : 25 deg.C / 58 %RH

Remarks : Battery circuit side

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Engineer : Yosuke Ishikawa



Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN: SLS-05

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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

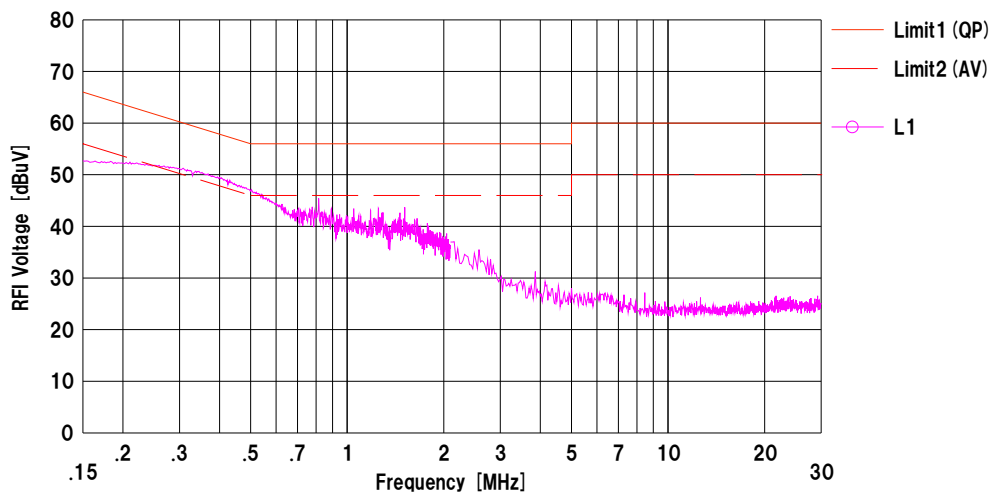
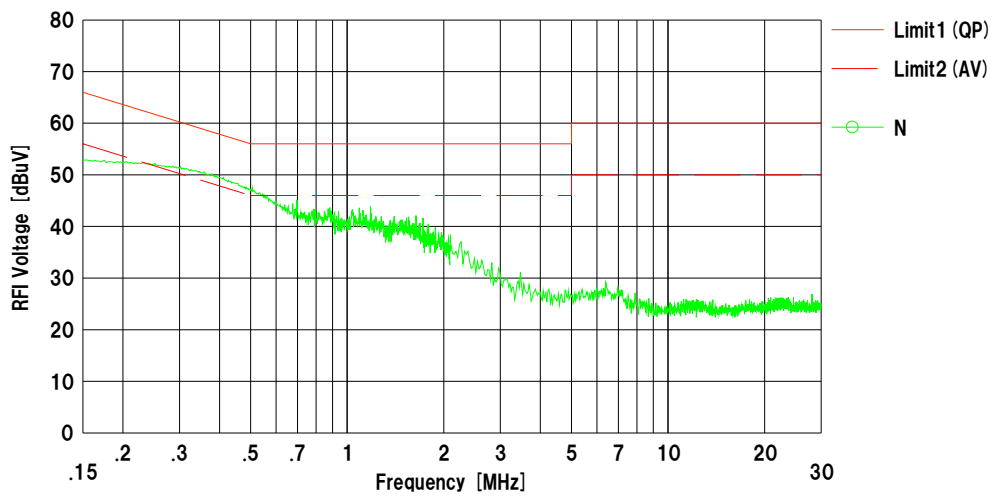
UL Japan, Inc. Shonan EMC Lab. No.6 Shielded Room
Date : 2017/08/12

Mode : BLE 2402MHz
Power : 120 V / 60 Hz (DC 5 V)
Temp./Humi. : 25 deg.C / 48 %RH

Remarks : USB circuit side

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Engineer : Makoto Hosaka



Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN (AMN) : SLS-03

UL Japan, Inc.

Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

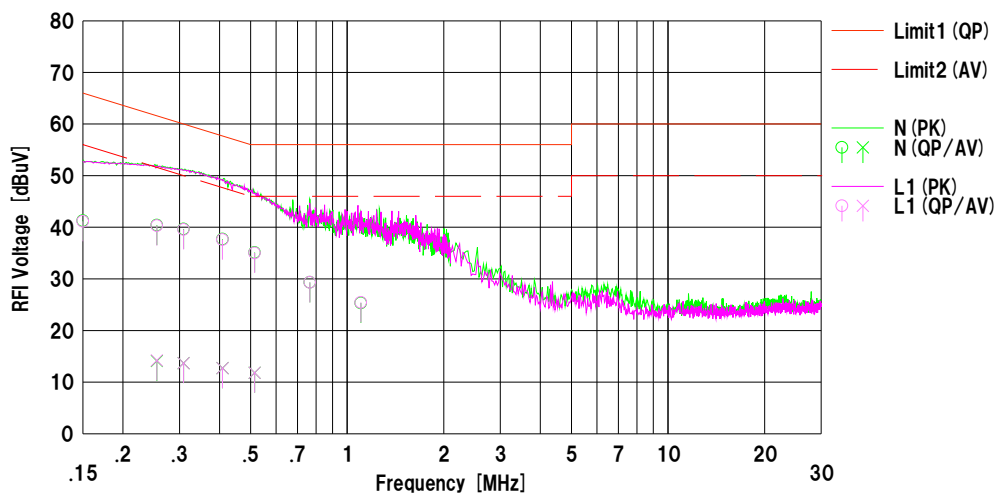
UL Japan, Inc. Shonan EMC Lab. No.6 Shielded Room
Date : 2017/08/12

Mode : BLE 2440MHz
Power : 120 V / 60 Hz (DC 5 V)
Temp./Humi. : 25 deg.C / 48 %RH

Remarks : USB circuit side

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Engineer : Makoto Hosaka



No.	Freq. [MHz]	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP> [dBuV]	<AV> [dBuV]		<QP> [dBuV]	<AV> [dBuV]	<QP> [dBuV]	<AV> [dBuV]	<QP> [dB]	<AV> [dB]		
1	0.15000	28.90	---	12.37	41.27	---	66.00	56.00	24.7	---	N	
2	0.25502	28.00	1.70	12.40	40.40	14.10	61.59	51.59	21.1	37.4	N	
3	0.30911	27.30	1.30	12.38	39.68	13.68	59.99	49.99	20.3	36.3	N	
4	0.40855	25.30	0.30	12.40	37.70	12.70	57.68	47.68	19.9	34.9	N	
5	0.51436	22.70	-0.60	12.41	35.11	11.81	56.00	46.00	20.8	34.1	N	
6	0.76490	16.90	---	12.43	29.33	---	56.00	46.00	26.6	---	N	
7	1.10298	12.90	---	12.43	25.33	---	56.00	46.00	30.6	---	N	
8	0.15000	28.80	---	12.37	41.17	---	66.00	56.00	24.8	---	L1	
9	0.25502	27.90	1.80	12.40	40.30	14.20	61.59	51.59	21.2	37.3	L1	
10	0.30911	27.20	1.30	12.38	39.58	13.68	59.99	49.99	20.4	36.3	L1	
11	0.40855	25.20	0.30	12.40	37.60	12.70	57.68	47.68	20.0	34.9	L1	
12	0.51436	22.60	-0.60	12.41	35.01	11.81	56.00	46.00	20.9	34.1	L1	
13	0.76490	16.90	---	12.43	29.33	---	56.00	46.00	26.6	---	L1	
14	1.10298	13.00	---	12.43	25.43	---	56.00	46.00	30.5	---	L1	

Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN (AMN) : SLS-03

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Conducted Emission

DATA OF CONDUCTED EMISSION TEST

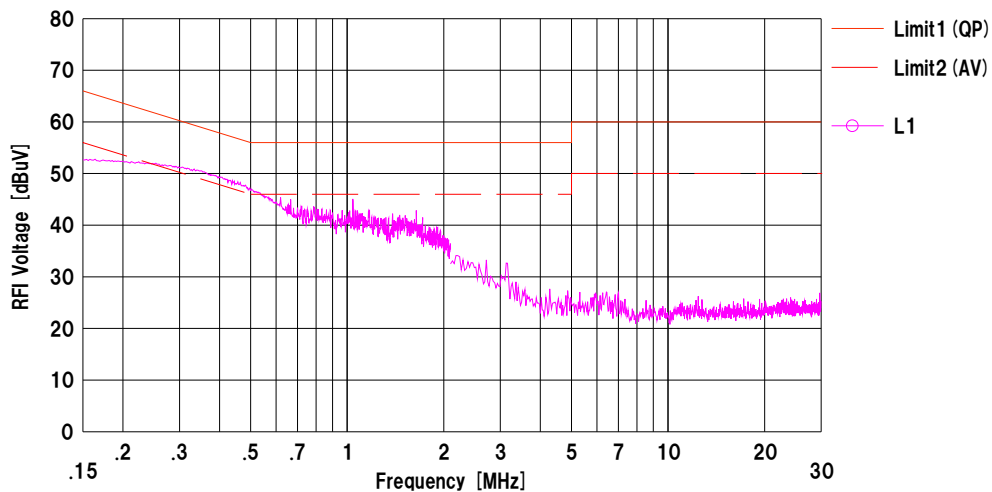
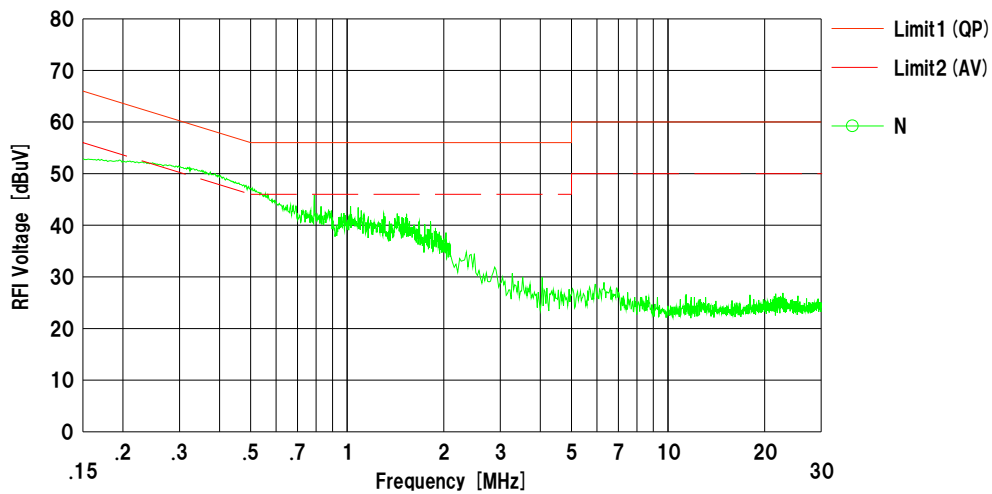
UL Japan, Inc. Shonan EMC Lab. No.6 Shielded Room
Date : 2017/08/12

Mode : BLE 2480MHz
Power : 120 V / 60 Hz (DC 5 V)
Temp./Humi. : 25 deg.C / 48 %RH

Remarks : USB circuit side

Limit1 : FCC 15C (15.207) QP
Limit2 : FCC 15C (15.207) AV

Engineer : Makoto Hosaka



Calculation: Result [dBuV] = Reading [dBuV] + C.Fac (LISN+Cable+ATT) [dB]
LISN (AMN) : SLS-03

UL Japan, Inc.

Shonan EMC Lab.

1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

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6dB Bandwidth

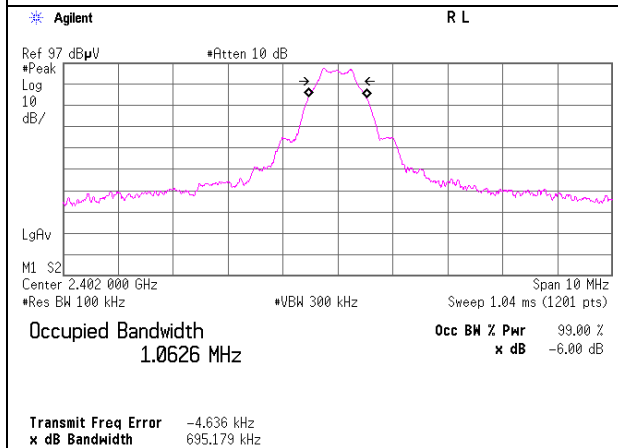
Test place Shonan EMC Lab. No.3 Shielded Room
Report No. 11837856S-B-R3
Date July 4, 2017
Temperature / Humidity 24 deg. C / 54 % RH
Engineer Kazutaka Takeyama
Mode Tx

Mode	Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
BLE	2402	0.695	> 500
	2440	0.679	> 500
	2480	0.690	> 500

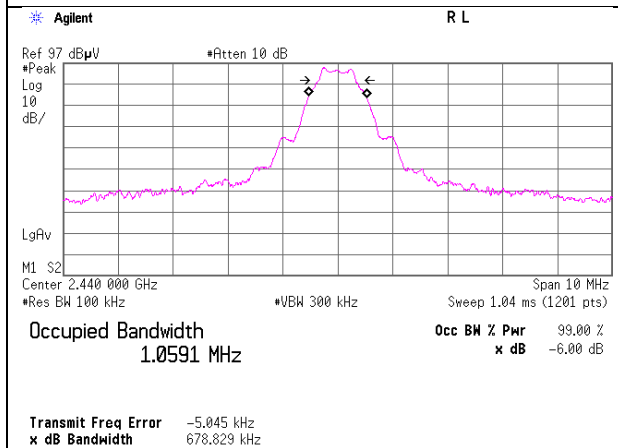
6dB Bandwidth

BLE

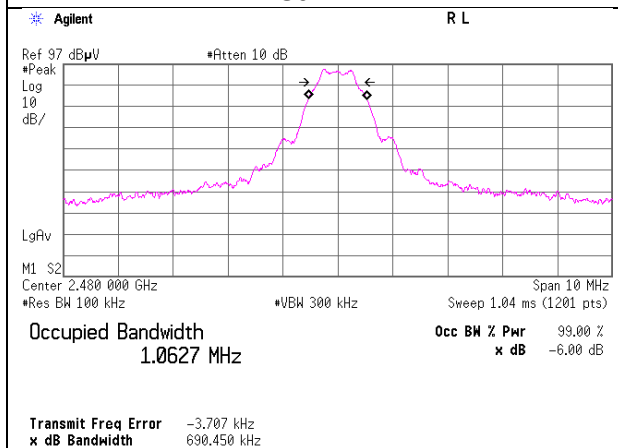
2402 MHz



2440 MHz



2480 MHz



Maximum Peak Output Power

Test place Shonan EMC Lab. No.3 Shielded Room
Report No. 11837856S-B-R3
Date July 4, 2017
Temperature / Humidity 24 deg. C / 54 % RH
Engineer Kazutaka Takeyama
Mode Tx

(* P/M: Power Meter with power sensor)

Freq. [MHz]	P/M (Peak) Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2402	-12.20	1.80	9.80	-0.60	0.87	30.00	1000	30.60
2440	-12.05	1.81	9.80	-0.44	0.90	30.00	1000	30.44
2480	-12.10	1.82	9.80	-0.48	0.90	30.00	1000	30.48

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Atten. Loss

The equipment and cables were not used for factor 0 dB of the data sheets.

Average Output Power
(Reference data for RF Exposure)

Test place : Shonan EMC Lab. No.3 Shielded Room
Report No. : 11837856S-B-R3
Date : July 4, 2017
Temperature / Humidity : 24 deg. C / 54 % RH
Engineer : Kazutaka Takeyama
Mode : Tx

(* P/M: Power Meter with power sensor, AV: Average)

Freq. [MHz]	P/M (AV) Reading [dBm]	Cable Loss [dB]	Atten. Loss [dB]	Result (Time average)		Duty factor [dB]	Result (Burst power average)	
				[dBm]	[mW]		[dBm]	[mW]
2402	-14.68	1.80	9.80	-3.08	0.49	1.50	-1.58	0.70
2440	-14.48	1.81	9.80	-2.87	0.52	1.50	-1.37	0.73
2480	-14.88	1.82	9.80	-3.26	0.47	1.50	-1.76	0.67

Sample Calculation:

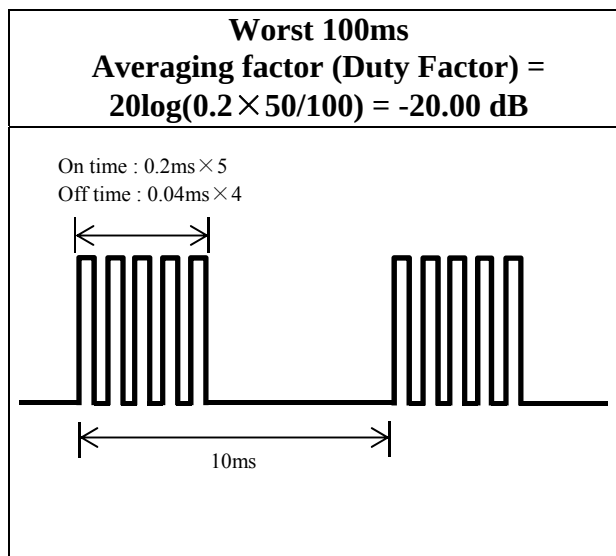
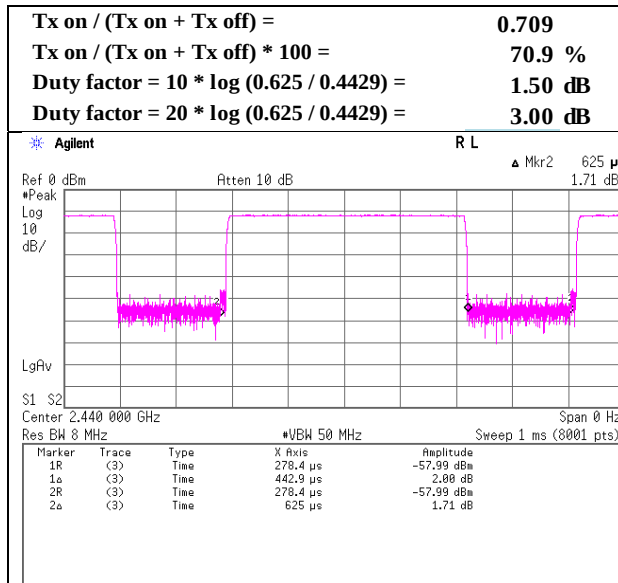
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Atten. Loss + Duty Factor

Deviation = Typical Power + Power Range - Result

The equipment and cables were not used for factor 0 dB of the data sheets.

Averaging factor (Duty Factor)

Test place	Shonan EMC Lab. No.3 Shielded Room
Report No.	11837856S-B-R3
Date	July 4, 2017
Temperature / Humidity	24 deg. C / 54 % RH
Engineer	Kazutaka Takeyama
Mode	Tx



* Since the burst rate is not different between the channels, the data has been obtained on the representative channel.

* Worst TX Duty cycle BLE is Advertising mode (Refer to BLE Worst TX Duty sheet).

The actual measurement value was applied as Averaging factor (Duty Factor).

Radiated Spurious Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.3
Date	August 4, 2017	August 2, 2017	August 3, 2017
Temperature / Humidity	23 deg. C / 65 % RH	23 deg. C / 62 % RH	20 deg. C / 70 % RH
Engineer	Hikaru Shirasawa (30-1000MHz)	Yosuke Ishikawa (1-13GHz)	Yosuke Ishikawa (13-26.5GHz)
Mode	Tx BT LE 2402 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	359.997	QP	37.86	14.85	7.08	31.61	0.00	28.18	46.00	17.8	100	268	
Hori.	431.993	QP	40.88	16.44	7.56	31.62	0.00	33.26	46.00	12.7	100	110	
Hori.	503.994	QP	38.36	17.82	7.95	31.59	0.00	32.54	46.00	13.4	176	113	
Hori.	647.993	QP	35.66	19.47	8.67	31.61	0.00	32.19	46.00	13.8	130	137	
Hori.	2390.000	PK	47.67	27.17	13.74	40.85	2.43	50.16	73.90	23.7	161	204	
Hori.	4804.000	PK	47.52	31.13	6.02	41.86	2.43	45.24	73.90	28.7	150	1	
Hori.	7206.000	PK	50.37	36.43	7.33	41.18	2.43	55.38	73.90	18.5	175	322	
Hori.	9608.000	PK	46.43	38.28	8.41	40.59	2.43	54.96	73.90	18.9	150	2	
Hori.	12010.000	PK	46.75	39.15	9.30	40.20	2.43	57.43	73.90	16.5	150	2	
Hori.	19215.880	PK	46.65	40.44	8.30	45.06	-9.54	40.79	73.90	33.1	145	31	
Vert.	67.683	QP	42.26	6.62	7.17	31.88	0.00	24.17	40.00	15.8	100	51	
Vert.	72.003	QP	46.17	6.27	7.50	31.87	0.00	28.07	40.00	11.9	100	104	
Vert.	147.199	QP	28.73	14.70	8.60	31.80	0.00	20.23	43.50	23.2	100	28	
Vert.	360.002	QP	38.79	14.85	7.08	31.61	0.00	29.11	46.00	16.8	157	189	
Vert.	431.994	QP	43.26	16.44	7.56	31.62	0.00	35.64	46.00	10.3	133	245	
Vert.	503.991	QP	40.17	17.82	7.95	31.59	0.00	34.35	46.00	11.6	100	231	
Vert.	2390.000	PK	47.24	27.17	13.74	40.85	2.43	49.73	73.90	24.2	254	101	
Vert.	4804.000	PK	47.75	31.13	6.02	41.86	2.43	45.47	73.90	28.4	150	1	
Vert.	7206.000	PK	49.46	36.43	7.33	41.18	2.43	54.47	73.90	19.4	183	188	
Vert.	9608.000	PK	46.48	38.28	8.41	40.59	2.43	55.01	73.90	18.9	150	2	
Vert.	12010.000	PK	45.75	39.15	9.30	40.20	2.43	56.43	73.90	17.5	150	3	
Vert.	19215.880	PK	46.57	40.44	8.30	45.06	-9.54	40.71	73.90	33.1	134	251	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (3.97 m / 3.0 m) = 2.43 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2390.000	AV	36.33	27.17	13.74	40.85	-17.00	2.43	21.82	53.90	32.1	*1)
Hori.	4804.000	AV	39.62	31.13	6.02	41.86	-17.00	2.43	20.34	53.90	33.6	
Hori.	7206.000	AV	42.45	36.43	7.33	41.18	-17.00	2.43	30.46	53.90	23.4	
Hori.	9608.000	AV	37.96	38.28	8.41	40.59	-17.00	2.43	29.49	53.90	24.4	
Hori.	12010.000	AV	37.25	39.15	9.30	40.20	-17.00	2.43	30.93	53.90	23.0	
Hori.	19215.880	AV	36.62	40.44	8.30	45.06	-17.00	-9.54	13.76	53.90	40.1	
Vert.	2390.000	AV	38.52	27.17	13.74	40.85	-17.00	2.43	24.01	53.90	29.9	*1)
Vert.	4804.000	AV	39.69	31.13	6.02	41.86	-17.00	2.43	20.41	53.90	33.5	
Vert.	7206.000	AV	41.48	36.43	7.33	41.18	-17.00	2.43	29.49	53.90	24.4	
Vert.	9608.000	AV	38.25	38.28	8.41	40.59	-17.00	2.43	29.78	53.90	24.1	
Vert.	12010.000	AV	37.26	39.15	9.30	40.20	-17.00	2.43	30.94	53.90	23.0	
Vert.	19215.880	AV	36.38	40.44	8.30	45.06	-17.00	-9.54	13.52	53.90	40.4	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (3.97 m / 3.0 m) = 2.43 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

20 dBc Data Sheet (RBW 100 kHz, VBW 300 kHz)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2402.000	PK	93.50	27.21	13.75	40.84	2.43	96.05	-	-	Carrier
Hori.	2400.000	PK	41.79	27.20	13.74	40.84	2.43	44.32	76.05	31.7	
Vert.	2402.000	PK	91.30	27.21	13.75	40.84	2.43	93.85	-	-	Carrier
Vert.	2400.000	PK	41.04	27.20	13.74	40.84	2.43	43.57	73.85	30.3	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (3.97 m / 3.0 m) = 2.43 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

UL Japan, Inc.

Shonan EMC Lab.

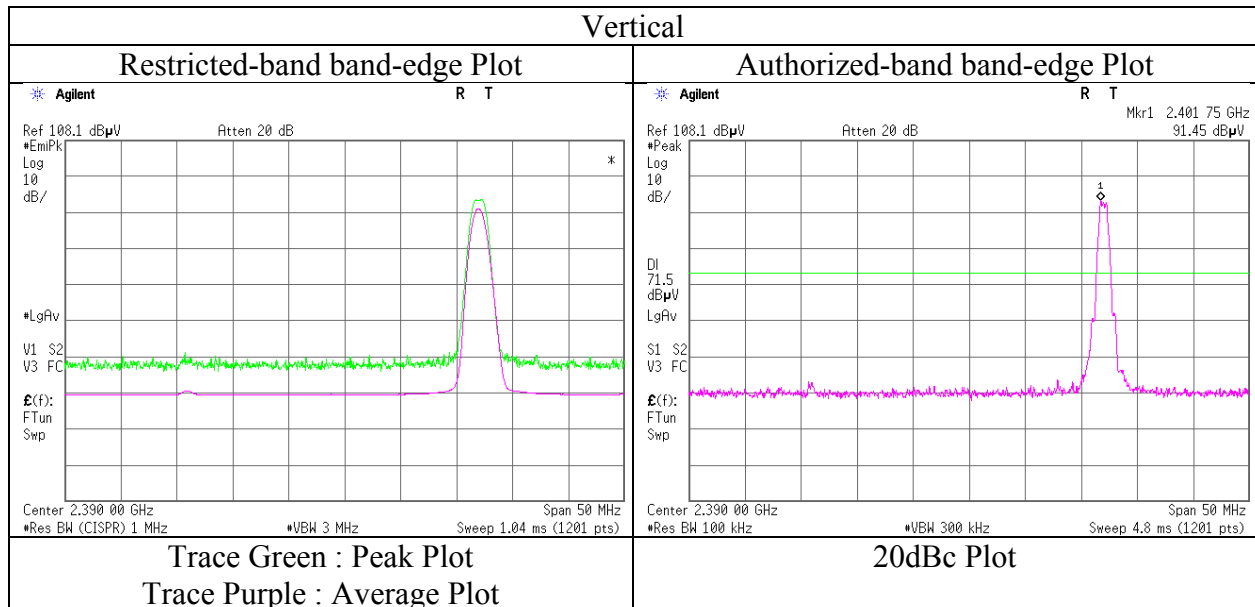
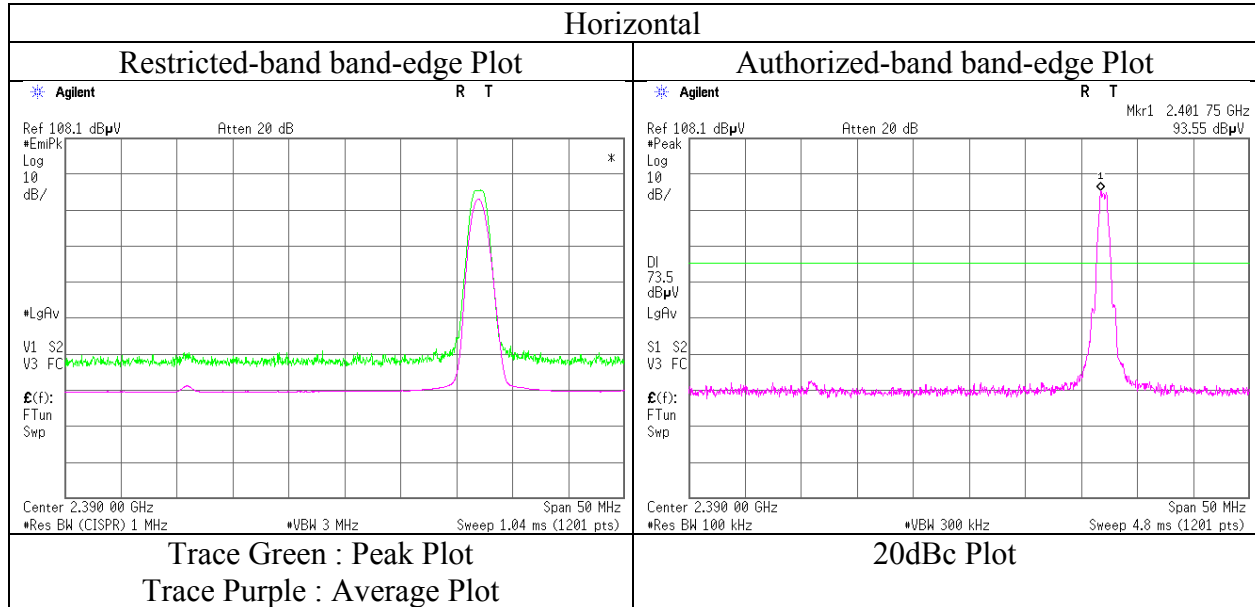
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken, 259-1220 JAPAN

Telephone : +81 463 50 6400

Facsimile : +81 463 50 6401

Radiated Spurious Emission (Reference Plot for band-edge)

Test place	Shonan EMC Lab. No.2 Semi Anechoic Chamber
Date	August 2, 2017
Temperature / Humidity	23 deg. C / 62 % RH
Engineer	Yosuke Ishikawa
Mode	Tx BT LE 2402 MHz



* Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.3
Date	August 4, 2017	August 2, 2017	August 3, 2017
Temperature / Humidity	23 deg. C / 65 % RH	23 deg. C / 62 % RH	20 deg. C / 70 % RH
Engineer	Hikaru Shirasawa (30-1000MHz)	Yosuke Ishikawa (1-13GHz)	Yosuke Ishikawa (13-26.5GHz)
Mode	Tx BT LE 2440 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	360.001	QP	38.57	14.85	7.08	31.61	0.00	28.89	46.00	17.1	100	261	
Hori.	431.997	QP	41.28	16.44	7.56	31.62	0.00	33.66	46.00	12.3	100	110	
Hori.	503.992	QP	35.53	17.82	7.95	31.59	0.00	29.71	46.00	16.2	167	276	
Hori.	647.993	QP	34.00	19.47	8.67	31.61	0.00	30.53	46.00	15.4	130	128	
Hori.	4880.000	PK	47.74	31.29	6.03	41.76	2.43	45.73	73.90	28.2	150	2	
Hori.	7320.000	PK	50.56	36.63	7.34	41.27	2.43	55.69	73.90	18.2	211	324	
Hori.	9760.000	PK	45.90	38.52	8.44	40.62	2.43	54.67	73.90	19.2	150	1	
Hori.	12200.000	PK	44.94	39.15	9.32	40.17	2.43	55.67	73.90	18.2	150	2	
Hori.	19519.920	PK	46.14	40.34	8.39	45.01	-9.54	40.32	73.90	33.5	113	34	
Vert.	68.183	QP	42.46	6.55	7.20	31.88	0.00	24.33	40.00	15.6	100	51	
Vert.	71.999	QP	46.14	6.27	7.50	31.87	0.00	28.04	40.00	11.9	100	91	
Vert.	151.880	QP	29.58	14.92	8.69	31.80	0.00	21.39	43.50	22.1	100	45	
Vert.	359.993	QP	39.57	14.85	7.08	31.61	0.00	29.89	46.00	16.1	164	179	
Vert.	431.992	QP	44.24	16.44	7.56	31.62	0.00	36.62	46.00	9.3	136	224	
Vert.	503.994	QP	39.00	17.82	7.95	31.59	0.00	33.18	46.00	12.8	100	230	
Vert.	4880.000	PK	46.05	31.29	6.03	41.76	2.43	44.04	73.90	29.9	150	1	
Vert.	7320.000	PK	49.72	36.63	7.34	41.27	2.43	54.85	73.90	19.1	167	138	
Vert.	9760.000	PK	45.76	38.52	8.44	40.62	2.43	54.53	73.90	19.4	150	2	
Vert.	12200.000	PK	45.09	39.15	9.32	40.17	2.43	55.82	73.90	18.1	150	1	
Vert.	19519.920	PK	46.44	40.34	8.39	45.01	-9.54	40.62	73.90	33.2	121	234	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.97\text{ m} / 3.0\text{ m}) = 2.43\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	4880.000	AV	39.63	31.29	6.03	41.76	-17.00	2.43	20.62	53.90	33.3	
Hori.	7320.000	AV	43.21	36.63	7.34	41.27	-17.00	2.43	31.34	53.90	22.6	
Hori.	9760.000	AV	36.92	38.52	8.44	40.62	-17.00	2.43	28.69	53.90	25.2	
Hori.	12200.000	AV	36.87	39.15	9.32	40.17	-17.00	2.43	30.60	53.90	23.3	
Hori.	19519.920	AV	36.66	40.34	8.39	45.01	-17.00	-9.54	13.84	53.90	40.1	
Vert.	4880.000	AV	39.63	31.29	6.03	41.76	-17.00	2.43	20.62	53.90	33.3	
Vert.	7320.000	AV	40.16	36.63	7.34	41.27	-17.00	2.43	28.29	53.90	25.6	
Vert.	9760.000	AV	37.98	38.52	8.44	40.62	-17.00	2.43	29.75	53.90	24.2	
Vert.	12200.000	AV	36.93	39.15	9.32	40.17	-17.00	2.43	30.66	53.90	23.2	
Vert.	19519.920	AV	36.69	40.34	8.39	45.01	-17.00	-9.54	13.87	53.90	40.0	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : $20\log(3.97\text{ m} / 3.0\text{ m}) = 2.43\text{ dB}$

13 GHz - 40 GHz : $20\log(1.0\text{ m} / 3.0\text{ m}) = -9.54\text{ dB}$

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission

Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.3
Date	August 4, 2017	August 2, 2017	August 3, 2017
Temperature / Humidity	23 deg. C / 65 % RH	23 deg. C / 62 % RH	20 deg. C / 70 % RH
Engineer	Hikaru Shirasawa (30-1000MHz)	Yosuke Ishikawa (1-13GHz)	Yosuke Ishikawa (13-26.5GHz)
Mode	Tx BT LE 2480 MHz		

(* PK: Peak, AV: Average, QP: Quasi-Peak)

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [deg]	Remark
Hori.	359.997	QP	37.92	14.85	7.08	31.61	0.00	28.24	46.00	17.7	100	265	
Hori.	431.997	QP	41.82	16.44	7.56	31.62	0.00	34.20	46.00	11.8	100	95	
Hori.	503.994	QP	37.56	17.82	7.95	31.59	0.00	31.74	46.00	14.2	169	276	
Hori.	647.990	QP	33.91	19.47	8.67	31.61	0.00	30.44	46.00	15.5	135	129	
Hori.	2483.500	PK	48.59	27.49	13.81	40.81	2.43	51.51	73.90	22.4	155	206	
Hori.	4960.000	PK	38.26	31.46	6.04	41.65	2.43	36.54	73.90	37.4	150	2	
Hori.	7440.000	PK	49.90	36.84	7.37	41.36	2.43	55.18	73.90	18.7	163	326	
Hori.	9920.000	PK	45.29	38.76	8.48	40.66	2.43	54.30	73.90	19.6	150	2	
Hori.	12400.000	PK	45.72	39.15	9.34	40.14	2.43	56.50	73.90	17.4	150	1	
Hori.	19839.880	PK	46.01	40.24	8.45	45.11	-9.54	40.05	73.90	33.8	146	36	
Vert.	68.181	QP	42.36	6.55	7.20	31.88	0.00	24.23	40.00	15.7	100	57	
Vert.	71.996	QP	46.21	6.27	7.50	31.87	0.00	28.11	40.00	11.8	100	119	
Vert.	147.676	QP	29.25	14.73	8.61	31.80	0.00	20.79	43.50	22.7	100	46	
Vert.	359.998	QP	37.85	14.85	7.08	31.61	0.00	28.17	46.00	17.8	195	217	
Vert.	431.990	QP	45.70	16.44	7.56	31.62	0.00	38.08	46.00	7.9	132	215	
Vert.	503.992	QP	41.63	17.82	7.95	31.59	0.00	35.81	46.00	10.1	100	225	
Vert.	2483.500	PK	47.78	27.49	13.81	40.81	2.43	50.70	73.90	23.2	212	198	
Vert.	4960.000	PK	47.88	31.46	6.04	41.65	2.43	46.16	73.90	27.7	150	2	
Vert.	7440.000	PK	49.42	36.84	7.37	41.36	2.43	54.70	73.90	19.2	163	228	
Vert.	9920.000	PK	45.09	38.76	8.48	40.66	2.43	54.10	73.90	19.8	150	1	
Vert.	12400.000	PK	45.48	39.15	9.34	40.14	2.43	56.26	73.90	17.6	150	2	
Vert.	19839.880	PK	46.07	40.24	8.45	45.11	-9.54	40.11	73.90	33.7	132	224	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (3.97 m / 3.0 m) = 2.43 dB

13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Average measurement value with duty factor

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Duty Factor [dB]	Distance Factor [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori.	2483.500	AV	40.49	27.49	13.81	40.81	-17.00	2.43	26.41	53.90	27.5	*1)
Hori.	4960.000	AV	39.22	31.46	6.04	41.65	-17.00	2.43	20.50	53.90	33.4	
Hori.	7440.000	AV	42.56	36.84	7.37	41.36	-17.00	2.43	30.84	53.90	23.1	
Hori.	9920.000	AV	37.17	38.76	8.48	40.66	-17.00	2.43	29.18	53.90	24.7	
Hori.	12400.000	AV	37.07	39.15	9.34	40.14	-17.00	2.43	30.85	53.90	23.1	
Hori.	19839.880	AV	36.80	40.24	8.45	45.11	-17.00	-9.54	13.84	53.90	40.1	
Vert.	2483.500	AV	37.06	27.49	13.81	40.81	-17.00	2.43	22.98	53.90	30.9	*1)
Vert.	4960.000	AV	38.91	31.46	6.04	41.65	-17.00	2.43	20.19	53.90	33.7	
Vert.	7440.000	AV	41.45	36.84	7.37	41.36	-17.00	2.43	29.73	53.90	24.2	
Vert.	9920.000	AV	37.22	38.76	8.48	40.66	-17.00	2.43	29.23	53.90	24.7	
Vert.	12400.000	AV	36.93	39.15	9.34	40.14	-17.00	2.43	30.71	53.90	23.2	
Vert.	19839.880	AV	36.92	40.24	8.45	45.11	-17.00	-9.54	13.96	53.90	39.9	

Result = Reading + Ant.Fac. + Loss (Cable+(Attenuator or Filter)(below 18 GHz)) - Gain(Amplifier) + Duty factor + Distance factor

Distance factor : 1 GHz - 13 GHz : 20log (3.97 m / 3.0 m) = 2.43 dB

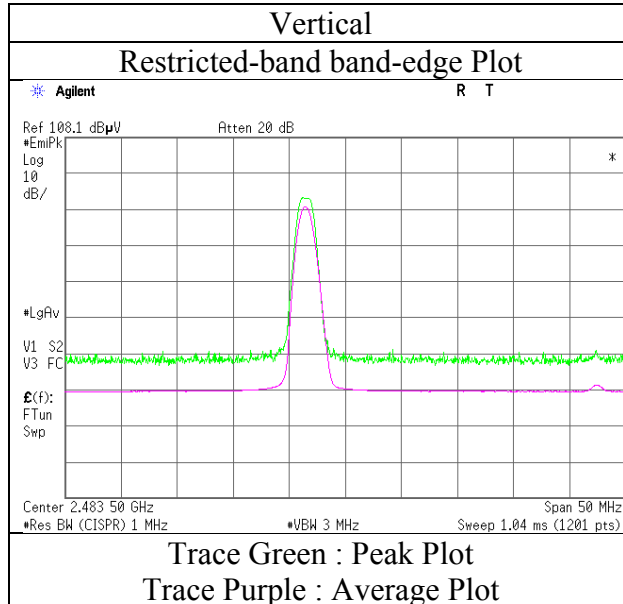
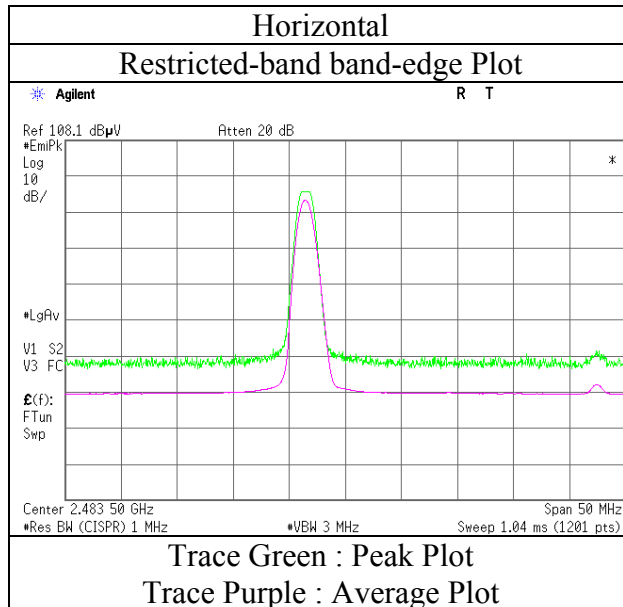
13 GHz - 40 GHz : 20log (1.0 m / 3.0 m) = -9.54 dB

Duty factor refer to "Duty factor Calculation chart" sheet.

*1) Not out of band emission (Leakage Power)

Radiated Spurious Emission **(Reference Plot for band-edge)**

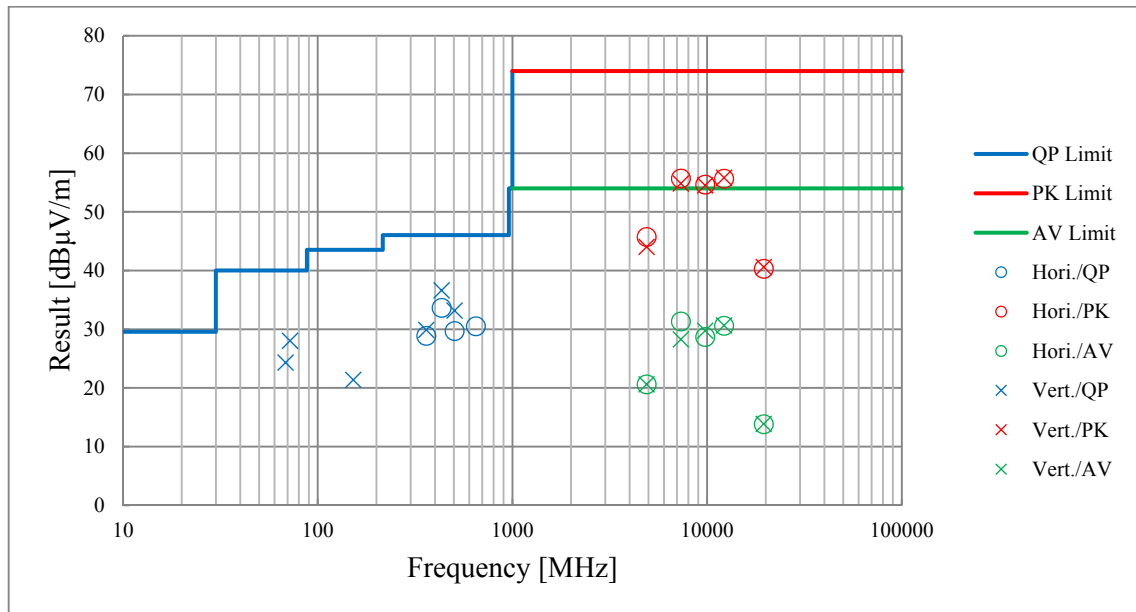
Test place : Shonan EMC Lab. No.2 Semi Anechoic Chamber
Date : August 2, 2017
Temperature / Humidity : 23 deg. C / 62 % RH
Engineer : Yosuke Ishikawa
Mode : Tx BT LE 2480 MHz



* Final result of restricted band edge was shown in tabular data.

Radiated Spurious Emission
(Plot data, Worst case)

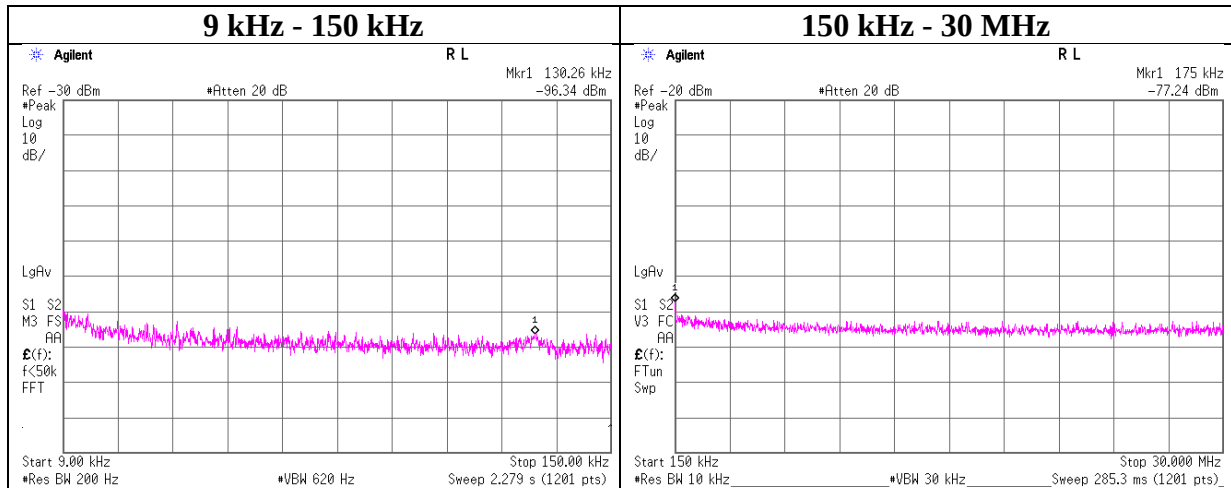
Test place	Shonan EMC Lab.		
Semi Anechoic Chamber	No.2	No.2	No.3
Date	August 4, 2017	August 2, 2017	August 3, 2017
Temperature / Humidity	23 deg. C / 65 % RH	23 deg. C / 62 % RH	20 deg. C / 70 % RH
Engineer	Hikaru Shirasawa (30-1000MHz)	Yosuke Ishikawa (1-13GHz)	Yosuke Ishikawa (13-26.5GHz)
Mode	Tx BT LE 2440 MHz		



*These plots data contains sufficient number to show the trend of characteristic features for EUT.

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.3 Shielded Room
Report No. : 11837856S-B-R3
Date : July 4, 2017
Temperature / Humidity : 24 deg. C / 54 % RH
Engineer : Kazutaka Takeyama
Mode : Tx BT LE 2402 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
130.26	-96.3	0.53	9.8	2.0	1	-84.0	300	6.0	-22.8	25.3	48.1	
175.00	-77.2	0.53	9.8	2.0	1	-64.9	300	6.0	-3.7	22.7	26.4	

$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$

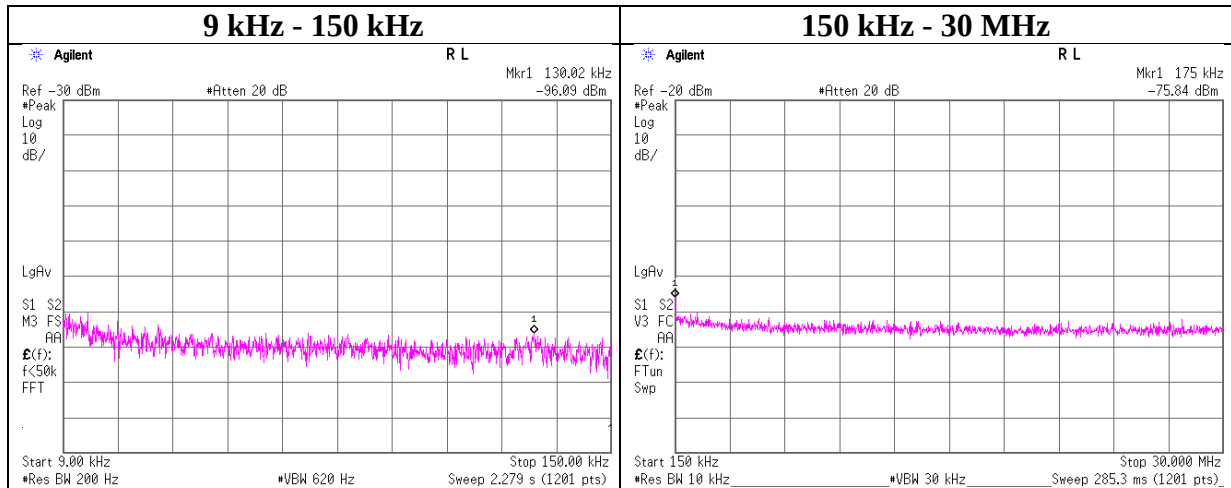
$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.3 Shielded Room
Report No. : 11837856S-B-R3
Date : July 4, 2017
Temperature / Humidity : 24 deg. C / 54 % RH
Engineer : Kazutaka Takeyama
Mode : Tx BT LE 2440 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
130.02	-96.1	0.53	9.8	2.0	1	-83.8	300	6.0	-22.5	25.3	47.8	
175.00	-75.8	0.53	9.8	2.0	1	-63.5	300	6.0	-2.3	22.7	25.0	

$$E \text{ [dBuV/m]} = \text{EIRP [dBm]} - 20 \log (\text{Distance [m]}) + \text{Ground bounce [dB]} + 104.8 \text{ [dBuV/m]}$$

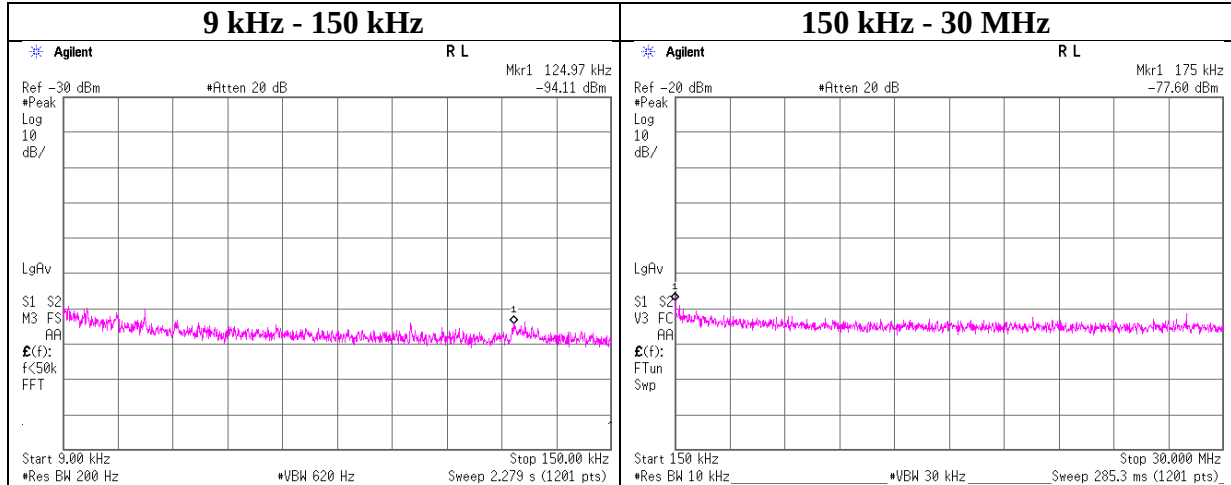
$$\text{EIRP [dBm]} = \text{Reading [dBm]} + \text{Cable loss [dB]} + \text{Attenuator Loss [dB]} + \text{Antenna gain [dBi]} + 10 * \log (N)$$

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

Conducted Spurious Emission

Test place : Shonan EMC Lab. No.3 Shielded Room
Report No. : 11837856S-B-R3
Date : July 4, 2017
Temperature / Humidity : 24 deg. C / 54 % RH
Engineer : Kazutaka Takeyama
Mode : Tx 11b 2480 MHz



Frequency [kHz]	Reading [dBm]	Cable Loss [dB]	Attenuator Loss [dB]	Antenna Gain* [dBi]	N (Number of Output)	EIRP [dBm]	Distance [m]	Ground bounce [dB]	E (field strength) [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
124.97	-94.1	0.53	9.8	2.0	1	-81.8	300	6.0	-20.5	25.6	46.1	
175.00	-77.6	0.53	9.8	2.0	1	-65.3	300	6.0	-4.0	22.7	26.7	

$E [dBuV/m] = EIRP [dBm] - 20 \log (Distance [m]) + Ground\ bounce [dB] + 104.8 [dBuV/m]$

$EIRP[dBm] = Reading [dBm] + Cable\ loss [dB] + Attenuator\ Loss [dB] + Antenna\ gain [dBi] + 10 * \log (N)$

N: Number of output

*2.0 dBi was applied to the test result based on KDB 558074 since antenna gain was less than 2.0 dBi.

Power Density

Test place Shonan EMC Lab. No.3 Shielded Room
Report No. 11837856S-B-R3
Date July 4, 2017
Temperature / Humidity 24 deg. C / 54 % RH
Engineer Kazutaka Takeyama
Mode Tx

Freq.	Reading	Cable Loss	Atten. Loss	Result	Limit	Margin
[MHz]	[dBm]	[dB]	[dB]	[dBm]	[dBm]	[dB]
2402.00	-27.73	1.80	9.80	-16.13	8.00	24.13
2440.00	-27.52	1.81	9.80	-15.91	8.00	23.91
2480.00	-27.61	1.82	9.80	-15.99	8.00	23.99

Sample Calculation:

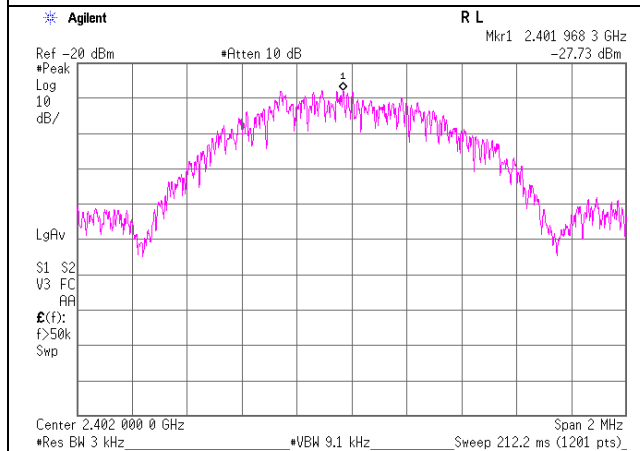
Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator Loss

*The equipment and cables were not used for factor 0 dB of the data sheets.

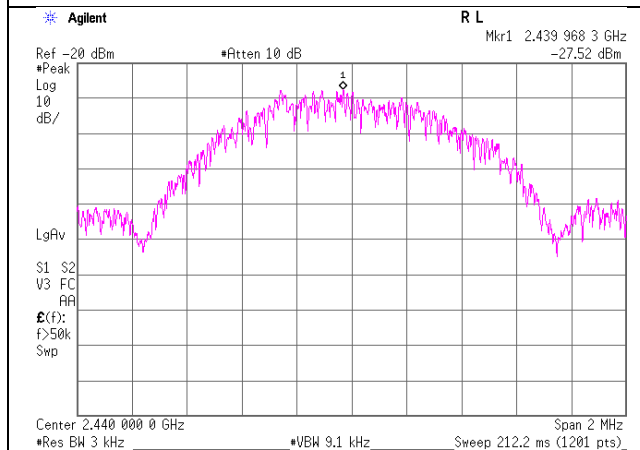
Power Density

BLE

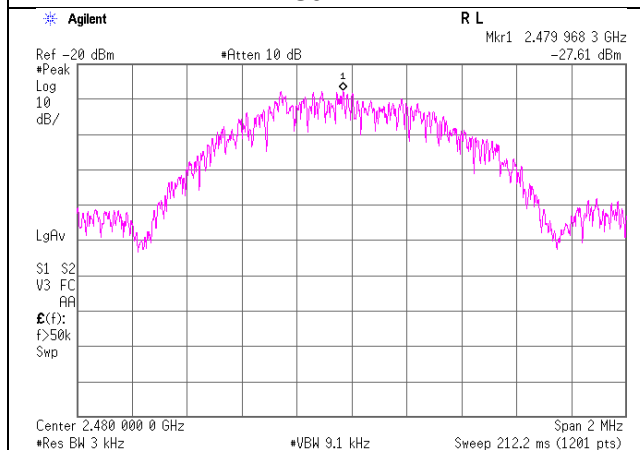
2402 MHz



2440 MHz



2480 MHz

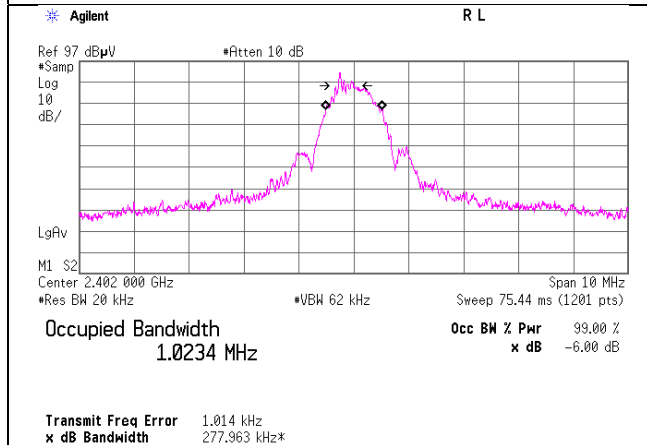


99%Occupied Bandwidth

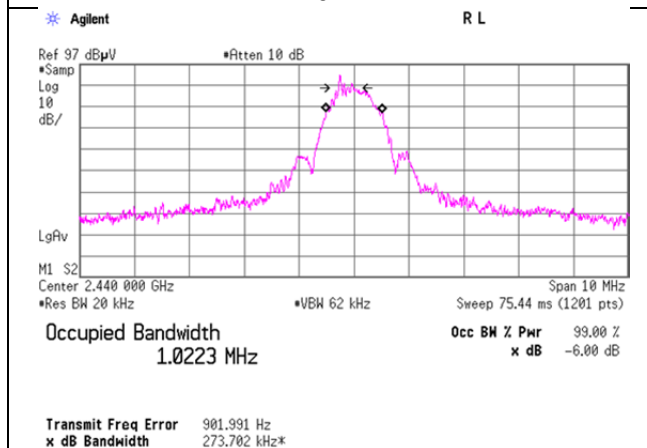
Test place Shonan EMC Lab. No.3 Shielded Room
Report No. 11837856S-B-R3
Date July 4, 2017
Temperature / Humidity 24 deg. C / 54 % RH
Engineer Kazutaka Takeyama
Mode Tx

BLE

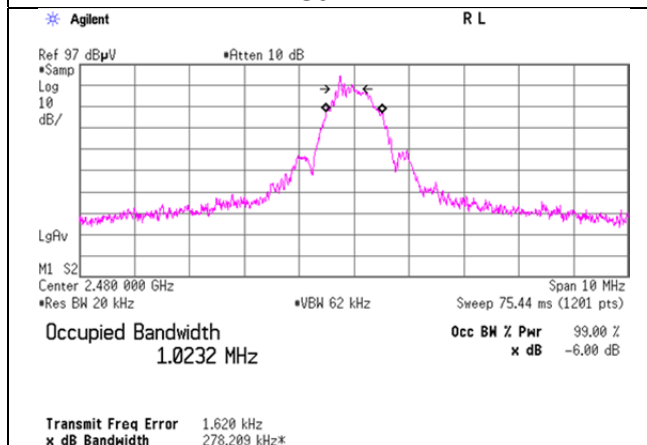
2402MHz



2440MHz



2480MHz



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APPENDIX 2: Test instruments

Test equipment (1/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
KSA-08	Spectrum Analyzer	Agilent	E4446A	MY461805 25	AT	2016/10/11 * 12
SCC-G13	Coaxial Cable	Suhner	SUCOFLEX 102	31599/2	AT	2017/03/23 * 12
SCC-G14	Coaxial Cable	Suhner	SUCOFLEX 102	31600/2	AT	2017/03/23 * 12
SPM-07	Power Meter	Agilent	8990B	MY510027 2	AT	2017/05/01 * 12
SPSS-04	Power sensor	Agilent	N1923A	MY532600 9	AT	2017/05/01 * 12
SOS-06	Humidity Indicator	A&D	AD-5681	4062118	AT,CE	2016/12/13 * 12
STS-03	Digital Hitester	Hioki	3805-50	080997823	AT,CE	2016/10/17 * 12
SJM-02	Measure	KOMELON	KMC-36	-	CE	-
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI, MF)	-	CE	-
SAT3-07	Attenuator	JFW	50HF-003N	-	CE	2016/09/23 * 12
SLS-05	LISN	Rohde & Schwarz	ENV216	100516	CE	2017/02/27 * 12
STR-08	Test Receiver	Rohde & Schwarz	ESW44	101581	CE	2016/11/08 * 12
SCC-C9/C10/S RSE-03	Coaxial Cable&RF Selector	Suhner/Suhner/TOYO	RG223U/141 PE/NS4906	-/0901-271 (RF Selector)	CE	2017/04/07 * 12
SCC-C9	Coaxial Cable	Suhner	RG223U	-	CE	2017/04/07 * 12
SLS-03	LISN	Rohde & Schwarz	ENV216	100513	CE	2017/02/27 * 12
SLS-04	LISN	Rohde & Schwarz	ENV216	100514	CE	2017/02/27 * 12
SAT3-11	Attenuator	JFW	50HF-003N	-	CE	2017/02/23 * 12
SOS-10	Humidity Indicator	A&D	AD-5681	4064561	CE	2016/10/12 * 12
STM-03	Terminator	TME	CT-01 BP	-	CE	2016/12/15 * 12
KJM-10	Measure	KOMELON	KMC-36	-	CE	-
STS-06	Digital Hitester	Hioki	3805-50	080997830	CE	2017/03/08 * 12
STR-06	Test Receiver	Rohde & Schwarz	ESCI	101259	CE	2017/03/23 * 12
SAF-02	Pre Amplifier	SONOMA	310N	290212	RE	2017/02/09 * 12
SAT6-02	Attenuator	JFW	50HF-006N	-	RE	2017/02/09 * 12
KAT3-10	Attenuator	JFW IND. INC.	50HF-003N	-	RE	2017/07/24 * 12
SBA-02	Biconical Antenna	Schwarzbeck	BBA9106	91032665	RE	2016/11/23 * 12
SCC-B1/B3/B5 /B7/B8/B13/SR SE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suh ner/Suhner/Suhner/Su hner/TOYO	8D2W/12DSF A/141PE/141 PE/141PE/14 1PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SCC-B2/B4/B6 /B7/B8/B13/SR SE-02	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suh ner/Suhner/Suhner/Su hner/TOYO	8D2W/12DSF A/141PE/141 PE/141PE/14 1PE/NS4906	-/0901-270(RF Selector)	RE	2017/04/07 * 12
SLA-06	Logperiodic Antenna	Schwarzbeck	VUSLP9111 B	195	RE	2017/01/05 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2016/10/12 * 12
STR-07	Test Receiver	Rohde & Schwarz	ESU26	100484	RE	2016/09/28 * 12
SAEC-02(NSA)	Semi-Anechoic Chamber	TDK	SAEC-02(NS A)	2	RE	2017/06/08 * 12

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Test equipment (2/2)

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
SRENT-10	Spectrum Analyzer	Agilent	E4440A	US41421511	RE	2016/12/05 * 12
SHA-02	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-726	RE	2016/08/09 * 12
SCC-G40	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S005	RE	2017/01/08 * 12
SCC-G22	Coaxial Cable	Suhner	SUCOFLEX 104	296199/4	RE	2017/05/08 * 12
SCC-G05	Coaxial Cable	Junkosha	J12J102207-00	APR-30-15-037	RE	2017/01/08 * 12
SFL-18	Highpass Filter	MICRO-TRONICS	HPM50111	119	RE	2017/04/20 * 12
SAT10-06	Attenuator	Agilent	8493C-010	74865	RE	2016/11/07 * 12
SAF-04	Pre Amplifier	TOYO Corporation	TPA0118-36	1440489	RE	2017/03/17 * 12
SAEC-02(SVS WR)	Semi-Anechoic Chamber	TDK	SAEC-02(SV SWR)	2	RE	2017/07/18 * 12
SOS-03	Humidity Indicator	A&D	AD-5681	4063325	RE	2016/10/12 * 12
STS-02	Digital Hitester	Hioki	3805-50	080997819	RE	2017/03/08 * 12
COTS-SEMI-1	EMI Software	TSJ	TEPTO-DV(RE,CE,RFI,M F)	-	RE	-
SRENT-08	Spectrum Analyzer	Agilent	E4448A	MY50180019	RE	2016/10/24 * 12
SHA-03	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-739	RE	2016/08/22 * 12
SHA-05	Horn Antenna	ETS LINDGREN	3160-09	LM4210	RE	2017/03/15 * 12
SAF-09	Pre Amplifier	TOYO Corporation	HAP18-26W	00000018	RE	2016/09/27 * 12
SCC-G20	Coaxial Cable	Junkosha	J12J102518-00	APR-15-15-003	RE	2017/04/20 * 12
SCC-G43	Coaxial Cable	HUBER+SUHNER	SUCOFLEX_104 E	SN MY 13406/4E	RE	2017/07/10 * 12
SCC-G07	Coaxial Cable	Junkosha	J12J103316-00	MAY-25-17-008	RE	2017/06/13 * 12
SCC-G33	Coaxial Cable	Junkosha	MWX241-01000KMSKMS	-	RE	2017/04/20 * 12
SAF-05	Pre Amplifier	TOYO Corporation	TPA0118-36	1440490	RE	2017/02/17 * 12
SFL-02	Highpass Filter	MICRO-TRONICS	HPM50111	051	RE	2016/11/29 * 12
SAT10-05	Attenuator(above1GHz)	Agilent	8493C-010	74864	RE	2016/11/07 * 12
SAEC-03(NSA)	Semi-Anechoic Chamber	TDK	SAEC-03(NSA)	3	RE	2017/06/11 * 12
SOS-05	Humidity Indicator	A&D	AD-5681	4062518	RE	2016/10/12 * 12
SJM-02	Measure	KOMELON	KMC-36	-	RE	-
STS-03	Digital Hitester	Hioki	3805-50	080997823	RE	2016/10/17 * 12

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test Item: CE: Conducted Emission test
RE: Radiated Emission test
AT: Antenna Terminal Conducted test

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